REMARKS

Applicants have carefully reviewed the Office Action dated August 22, 2001. With this Amendment, Applicants have amended claims 8, 9, 12 and 15. Claims 1-16 remain pending in this application.

In paragraph 3 of the Office Action, the Examiner rejected claims 1-7 and 9-11 under 35 U.S.C. § 103(a) as being unpatentable over Konno et al. (U.S. Patent No. 5,089,732) in view of Weilbach et al. (U.S. Patent No. 5,019,738). The Examiner asserts that Konno et al. teach a spindle motor shaft and cylindrical radial bearing comprising: a cylindrical rotary member 7 attached to a rotary shaft 6b; a cylindrical fixed surface 2 surrounding rotary member 7, wherein the fixed surface 2 is spaced from rotary member 7 a predetermined distance determined by radial bearing 4; and armature coils 5 arranged about a peripheral surface of fixed surface 2 to rotate the rotor 6 and rotary shaft 6b. The Examiner admits that Konno et al. do not teach a rotary member having a coefficient of thermal expansion smaller than the fixed surface. However, the Examiner asserts that Weilbach et al. teach a motor bearing arrangement in which a cylindrical bearing sleeve 40 and rotary shaft 46 can be comprised of materials having a low coefficient of thermal expansion. More specifically, the Examiner contends that Table 1 (column 6) in Weilbach et al. discloses "successful bearing arrangements which conform to roughness profiles that provide high precision bearings with beneficial operating characteristics such as high stiffness, low velocity lift, etc." The Examiner concludes that it would have been obvious to one of ordinary skill in the art to utilize a ceramic material having a low coefficient of thermal expansion per Weilbach et al. with the cylindrical rotary member of Konno et al. in providing a high precision bearing.

Applicants respectfully disagree with the Examiner's conclusion with respect to the teachings of Konno et al. and Weilbach et al. In determining the differences between the prior art and the claims at issue under 35 U.S.C. § 103, the proper analysis is whether the claimed invention *as a whole* would have been obvious. S*ee* MPEP § 2141.02. Accordingly, the prior art reference must be considered in its entirety, including portions that would lead (i.e., "teach") away from the claimed invention. "The mere fact that references can be combined or modified does not render the resultant combination obvious unless the prior art suggests the desirability of the combination." MPEP § 2143.01 (citing *In re Mills*, 916 F.2d 680, 16 U.S.P.Q.2d 1430 (Fed. Cir. 1990). In short, absent a suggestion or motivation in the prior art to combine the teachings, rejection under 35 U.S.C. § 103(a) is improper.

Weilbach et al. disclose a gas-supported bearing including a rotary shaft 46 having an outer surface 48, and a fixed bearing sleeve 40 having an inner surface 44. The lower end of the rotary shaft 46, in turn, is coupled to an annular magnet assembly 52 and annular magnets 54 and 56, which together form part of an axial thrust bearing assembly. Weilbach et al. teach that to create a high precision, self-pressurizing gas support bearing, four separate parameters must be controlled. These include the geometry of the bearing and sleeve members, the aspect ratio of sleeve length to the shaft diameter, the surface texture (R_a) of the bearing surfaces, and the ratio of bearing surface depressions to the overall area of each bearing surface. Weilbach et al. further teach that steel, hard anodized aluminum and ceramic materials can be used for the fixed bearing sleeve 40 and rotary shaft 46.

While Weilbach et al. teach that a ceramic, steel and/or hard anodized aluminum material(s) can be used for the shaft and sleeve members, there is no suggestion or motivation in Weilbach et al. to select a material for the rotary shaft having a *lower* coefficient of thermal

expansion than the sleeve. Indeed, Weilbach et al. at column 14, lines 53-57 appear to teach the exact opposite:

> If the materials used in the bearing sleeve and shaft are properly *matched* with respect to thermal coefficients of expansion as can readily be done, extremely wide temperature operating ranges can be readily achieved.

(emphasis added). After reviewing the reference in detail, it is clear that Weilbach. et al. teach only that steel, hard anodized aluminum and/or ceramics can be utilized for the material of the sleeve and shaft members, provided they have either identical or closely matched coefficients of thermal expansion. Nothing in Weilbach et al. suggests the use of a material for the rotary member having a coefficient of thermal expansion *less* than that of the fixed surface. For example, Table 1 (column 6) discloses that steel and/or hard-anodized aluminum, which have coefficients of thermal expansion on the order of 3 to 6 times greater than that of a ceramic material such as silicon carbide, can be used for the sleeve material.

In contrast, claim 1 recites:

> 1. A motor comprising:
> a rotary shaft; and
> a bearing for radially supporting the rotary shaft, wherein the bearing includes:
> a cylindrical rotary member connected to the rotary shaft;
> a cylindrical fixed surface surrounding the rotary member, wherein the fixed surface is spaced from the rotary member by a predetermined distance, and wherein the material of the rotary member has a coefficient of thermal expansion that is smaller than that of the material of the fixed surface; and
> armature coils arranged about a peripheral surface of the fixed surface to rotate the rotary shaft.

(emphasis added). Similarly, claim 9, as amended, recites:

> 9. A motor comprising:
> a rotary shaft; and
> a bearing for radially supporting the rotary shaft, wherein the bearing includes:
> a cylindrical rotary member connected to the rotary shaft;

> a cylindrical fixed surface surrounding the rotary member, wherein the fixed surface is spaced from the rotary member by a predetermined distance, <u>and wherein the rotary member is made of a material having a coefficient of thermal expansion that is $5x10^{-6}/°C$ or less, and which is smaller than the coefficient of thermal expansion of the material of the fixed surface</u>; and
>
> armature coils arranged about a peripheral surface of the fixed surface to rotate the rotary shaft.

(emphasis added).

Unlike the present invention, the Weilbach et al. patent does not teach the additional limitation that the rotary member be made of a material having a coefficient of thermal expansion of $5x10^{-6}/°C$ or less, or that the rotary member have a coefficient of thermal expansion *less* than that of the fixed surface. In utilizing a material for the rotary member having a smaller coefficient of thermal expansion, Applicants' claimed motor can be operated at higher rotational speeds (*i.e.,* at hotter temperatures) with a smaller clearance. Since there is no suggestion or motivation in the prior art references to select a material for the rotary member having a *lower* coefficient of thermal expansion than that of the fixed surface, it is respectfully asserted that Applicants' claimed invention is not obvious over Konno et al. in view of Weilbach et al.

Since claims 1 and 9, as amended, are allowable, dependent claims 2-7 and 10-11 are allowable for the reasons stated above, and since they add significant elements to distinguish them from the prior art.

In paragraph 4 of the Office Action, the Examiner also rejected claims 8 and 12 under 35 U.S.C. § 103(a) as being unpatentable over Konno et al. (U.S. Patent No. 5,089,732) and Weilbach et al. (U.S. Patent No. 5,019,738) as set forth *infra*, and further in view of either Becker (U.S. Patent No. 2,545,335) or Yassemi (U.S. Patent No. 4,284,917). The Examiner asserts that although neither Konno et al. nor Weilbach et al. teach a case accommodating the bearing, rotary member and fixed surface, wherein the case has a slit for cooling, Becker and/or

Yassemi teach that such openings can be used to cool the motor, bearing and stator. According to the Examiner:

> It would have been obvious to one having ordinary skill in the art at the time of the invention to modify the structure of Konno and Weilbach and provide a case accommodating the bearing with slits or openings per Becker or Yassemi since it would have been desireable to cool the motor.

Becker (U.S. Patent No. 2,545,335) discloses a hermetically sealed housing 1 containing a revolving stator 2 and a stationary rotor 3. Disposed within the revolving stator 2 are several radial openings 6 which are adapted to re-circulate cooling air or gas within housing 1 and the space enclosed by the revolving stator. In use, the rotation of stator 2 forces the cooling air or gas through the radial openings 6 into a chamber 8. The evacuation of the cooling air or gas from the radial openings 6 into the chamber 8 causes a pressure drop within the space enclosed by the stator 2. As a result of this depressurization, the cooling air or gas from the chamber 8 is drawn back into the space enclosed by the revolving stator through the bearings 4.

Yassemi (U.S. Patent No. 4,284,917) discloses an electric motor having an outer housing 12, an inner housing 13 and an annular passageway 45 therebetween for circulating cooling water. *See* Figs. 1-2. In use, the cooling water enters through an inlet port 49 and passageway 50, both of which are disposed on cylinder 11, and travels through passageway 45 until it is withdrawn on the opposite side of the motor through opening 54 and outlet port 56. Disposed at the upper end of the inner housing 13 are several radial blind openings 47 which are adapted to dissipate heat during operation of the motor.

Applicants respectfully assert that neither Becker nor Yassemi, when combined with Konno et al. and Weilbach et al., teach the slits claimed in the present invention. Unlike the hermetically sealed case in Becker, which re-circulates the cooling air or gas through several radial openings 6 to cool the motor, the slits claimed in the present invention do not use re-

circulated (i.e., heated) cooling air or gas to cool the fixed surface. Instead, the present invention claims one or more slits disposed on the *outer* surface of the case which are adapted to dissipate heat generated by the bearing and the fixed surface. Claim 8 [12], as amended, recites:

> 8. The motor according to claim 1 [9], further comprising a case for accommodating the bearing, the rotating member, and the fixed surface, <u>wherein the case has an outer surface with one or more slits disposed thereon for cooling the bearing and the fixed surface</u>.

(emphasis added). Thus, unlike Becker which employs several radial openings disposed within the case to cool the motor, the present invention claims a case having one or more slits disposed on the outer surface of the case to dissipate heat generated by the bearing and fixed surface. As such, it is respectfully asserted that it would not have been obvious to one of ordinary skill in the art to combine Becker with Konno et al. and Weilbach et al.

With respect to Yassemi, since the rotary member claimed in the present invention is comprised of a material having a smaller coefficient of thermal expansion than that of the fixed surface, the slits claimed in the present invention can be disposed on the outer surface of the case, and are not required to dissipate heat generated from the rotary member. For the same reasons it would not have been obvious to select a material for the rotary cylinder having a lower coefficient of thermal expansion than that of the fixed surface. It would not have been obvious to utilize slits on the outer diameter of the case which are adapted to cool the fixed surface and the bearing, but not the rotary member.

In paragraph 5 of the Office Action, claims 13-16 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Konno et al. (U.S. Patent No. 5,089,732) in view of Weilbach et al. (U.S. Patent No. 5,019,738) and Yashiro (JP 2-16389). As with claims 1-7 and 9-11, the Examiner asserts that it would have been obvious to one of ordinary skill in the art to provide a ceramic material with a low coefficient of thermal expansion per Weilbach et al. as the material

for the cylindrical member of Konno et al. With respect to the Yashiro reference, the Examiner asserts that Yashiro discloses a turbo-molecular pump including rotor 17, rotor vanes 16, stator 11, stator vanes 19, and a motor 13/14 for rotating the rotor 17. Further, the Examiner asserts that Yashiro teaches non-contact, ceramic cylindrical bearings for radial and thrust bearings, and a fan for cooling the air bearing. The Examiner concludes that "it would have been obvious to employ the bearing on a turbo-molecular pump because high precision would be desireable in high speed applications such as the turbo pump in Yashiro, which also uses cylindrical bearings."

Yashiro appears to disclose a turbo molecular drag pump including a radial dynamic gas bearing 24 comprised of a shaft sleeve 21 fixed to a rotary shaft 15, wherein the radial dynamic gas bearing 24 is arranged on the bottom part of a driving member 30. In addition to the radial dynamic gas bearing 24, Yashiro also appears to disclose a thrust dynamic gas bearing 23 comprising a thrust plate 22 affixed to the rotary shaft 15.

For the reasons set-forth above, Applicants respectfully assert that the teachings of Konno et al., Weilbach et al. and Yashiro, alone or in combination, fail to teach a rotary member having a coefficient of thermal expansion less than that of the fixed surface. Furthermore, Applicants assert that Yashiro does not teach a cylindrical fixed surface surrounding the rotary member, wherein the fixed surface is spaced from the rotary member by a predetermined distance, as claimed in independent claim 13. Therefore, since none of the cited references teach these limitations, it is respectfully asserted that the obviousness rejection of claims 13-16 under 35 U.S.C. § 103(a) is improper, and that claims 13-16 are in condition for allowance.

Reexamination and reconsideration are requested. It is respectfully submitted that all of claims 1-16, as amended, are now in condition for allowance, and issuance of a Notice of

Allowance in due course is requested. If a telephone conference might be of assistance, please contact the undersigned attorney at (612) 677-9050.

Respectfully submitted,

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By their Attorney,

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